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ANALYSIS OF THE EFFECTIVENESS OF BUDGET DEFICIT FINANCING METHODS IN CÔTE D'IVOIRE USING A CREDIT SCORING MODEL[3]

After reaching the completion point of the Heavily Indebted Poor Countries (HIPC) initiative and the subsequent debt relief, Côte d'Ivoire decided to take the necessary measures to avoid a new public debt crisis. Ten years later, the country is at a crossroads with a rapidly growing debt. Given this situation, it is important to question the effectiveness of the methods of financing the budget deficit in Côte d'Ivoire. This article aims to develop a credit scoring model in order to analyse the efficiency of budget deficit financing modes using a sample of 3222 loan lines from the database of the Department of Public Debt and Grants of Ivory Coast. The results show that loans from bilateral and commercial banks can be considered as "risky" financing. This mode of financing has a less important impact on the probability of default. On the other hand, the results obtained with the estimation of the Logit model show that the probability of default is strongly reduced when the government is financed by bondholders and other debt instruments and multilateral institutions.
Keywords: Public debt; budget deficit; credit scoring; logistic regression; probability of default
JEL: H63; C25

Introduction

In the context of the reorganisation of public debt management, the issue of risk assessment is of renewed interest in the light of previous crises. After reaching the completion point of the Heavily Indebted Poor Countries (HIPC) Initiative, new public debt management tools were developed under an economic and financial programme with the IMF to avoid a high risk of debt distress. These include the Debt Sustainability Framework (DSF) developed by the International Monetary Fund (IMF), in which the Debt Sustainability Analysis (DSA) and the Medium Term Debt Management Strategy (MTDS) are arguably central.

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Thus, the economic literature offers several methods for analysing the sustainability of public debt. These have been used at some point as a warning tool for a country's debt trajectory. However, following the dynamics of re-indebtedness observed in certain emerging countries, notably in Côte d'Ivoire, it seems appropriate to study alternative methods of monitoring debt strategies. Indeed, the external debt of the Republic of Côte d'Ivoire rose from CFAF 971,7 billion in 1980 (45.2% of GDP) to CFAF 12381,0 billion in 1994 (268.2% of GDP) and then to CFAF 5748,6 billion in 2010 (46.6% of GDP).

Thus, CFAF 4090,02 billion were cancelled out of a stock of CFAF 6373,9 billion, i.e. a cancellation rate of 64.2%. This left a residual stock of CFAF 2283,9 billion.[4] Under this initiative, all resources resulting from HIPC debt relief have been directed to the poor. Hence, priority was given to basic social spending (education, health and other social areas essential for development). The HIPC initiative has given greater responsibility to recipient countries in the face of a new debt overhang crisis that may occur in the coming years. The cancellation of the entire debt stock is a way to reduce the burden of the past on future debt dynamics.

Thus, for Côte d'Ivoire, whose financing needs remain high, the important question is the nature of the financing to be sought in the future. It should be noted that after reaching the completion point of the HIPC Initiative and the subsequent debt relief, Côte d'Ivoire resorted to methods of mobilising resources on the financial markets to finance the National Development Plan (NDP). Thus, the total outstanding public debt portfolio, from 2012-2020, recorded strong growth from CFAF 4679,6 billion in 2012 to CFAF 16802,3 billion in 2020, with the debt/GDP ratio rising from 33.9% GDP in 2012 to 47.8% GDP in 2020.

In addition, debt service rose from 391,3 billion in 2012 to 1769,3 billion in 2019, an increase of 1378,0 billion CFA francs in seven years. In 2020, debt servicing will amount to CFAF 1926,2 billion (nearly 25% of the budget), up by 20% compared to the previous year's figures.[5] This evolution of the stock of public debt and its servicing[6] is likely to lead to difficulties that could weigh on the sustainability of public finances and lead, in the context of the elimination of direct monetary financing by the Central Bank, to a significant increase in taxes or a default on the debt. The burden of this debt has become such that the country devotes a large part of its budget to debt service payments. All too often, the repayment of this debt takes precedence over the vital needs of the population and mortgages all development prospects. As a result, the issue of public debt has come to the forefront more than ever. These are the reasons for this article.

In view of the increasing evolution of public debt, it is important to propose innovative tools to assess the performance of debt instruments. In this respect, credit scoring would be a way to avoid a high risk of debt distress because of its ability to predict the probability of default. Innovations in the application of credit scoring to a sovereign and the analysis of default can help to compare the performance of debt instruments and to determine the preferred financing to meet the financing need.

[4] Department of Public Debt and Grants (DDPD).
[5] Department of Public Debt and Grants (DDPD).
[6] Secretary of State to the Prime Minister, in charge of the Budget and the State Portfolio of Côte d'Ivoire (Communication to the Council of Ministers).

Therefore, the general objective of this article is to empirically analyse the modes of financing the budget deficit that can explain or justify the probability of default. With regard to our general objective, we formulate the following specific objectives:

- To show that certain financing methods are likely to lead to a default on public debt;
- To demonstrate that there are financing methods that are less likely to result in debt default;
- To prove that there are less "risky" modes of financing to be favoured in the context of budget deficit financing in Côte d'Ivoire.

This paper is divided into five sections. Section 1 provides an overview of credit scoring. Section 2 is devoted to the literature review on credit scoring. Sections 3 and 4 deal with the methodology and empirical results, respectively. Finally, section 5 explains the construction of the credit scoring model and analyses the results.

1. General View on Credit Scoring

Credit scoring is a statistical forecasting method that aims at associating to each credit application a score proportional to the borrower's probability.[7] It is the action of assessing the risk of default of a credit beneficiary on the basis of elements. This technique makes it possible to simplify the examination of credit files.

In the same sense, Flamam (1997) refers to scoring as a process of assigning a rating (or score) to a potential borrower to estimate the future performance of his loan.

For Caire and Kossmam (2003), this method uses quantitative measures of performance and characteristics of previous loans to predict the performance of future loans with similar characteristics. It neither approves nor rejects a loan application; rather, it can predict the probability of occurrence of poor performance (default) as defined by the lender.

Thomas et al. (2002) consider this technique as a set of decision models and underlying techniques that help in the decision to grant consumer credit.

Indeed, score models are risk measurement tools that use historical data and statistical techniques. Their purpose is to determine the effects of various borrower characteristics on their chance of default. They produce scores which are ratings that measure the default risk of potential or actual borrowers. Financial institutions can use these scores to classify borrowers into risk categories.[8]

Thus, the objective of scoring is to assess the financial situation of a company in a synthetic way and to classify it in the category of viable or defaulting companies.

[7] Percie Du Sert, A. M. (1999). Risk and credit control. economica edition, Paris, p. 36.
[8] Dietch, M., Petey, J. (2003). Mesure et gestion du risque de crédit dans les institutions financières. ed. Revue banque éditeur, Paris, p. 48.

To sum up, it can be concluded that credit scoring is a risk management tool that aims at predicting the probability of default of a new loan using previous loans. Thus, the purpose of credit scoring is to predict risk, not to explain it.

2. Theoretical Framework of Credit Scoring

There are several techniques for the construction of scoring models. Indeed, the implementation of a unidimensional approach, illustrated by the study of W. BREAVER in 1966, is considered as a first effort in the application of the statistical method.[9] This classification method is based on a single ratio.

The objective is to classify companies into one of two groups: defaulting or non-defaulting, on the basis of the most discriminating ratio. Beaver proceeded as follows: he ranked the companies according to the values taken by each ratio. Then he chose a critical threshold so that any firm with a ratio below this threshold is considered to be failing and any firm with a higher ratio is considered to be doing well. The critical threshold is determined in such a way as to maximise the good rating rate. It is this rate that will determine the most discriminating ratio.

Altman's (1968) research is the benchmark in the field of bankruptcy prediction. Altman's model was constructed using the discriminant analysis method and aimed to determine the algebraic equation that, using financial ratios, would best discriminate between failing and healthy firms. To construct his model, Altman used a sample of sixty-six firms, half of which were healthy and half bankrupt.

In 1991, Véronnault and Legault presented a model called the CA Score, similar to Altman's but based on more recent data. The sample was made up of Quebec manufacturing companies that had been in existence for more than five years and had sales of between 1 and 20 million dollars.

In addition, Conan and Holder have developed a model whose score allows a ranking of the most risky companies.

This model is implemented through five (05) phases, namely:

Stage 1: Definition of a study sample

Stage 2: Establishment of indicators to explain the bankruptcy

Stage 4: Assessment of the predictive quality of the indicators

Stage 5: Application of the method

This model uses five (05) variables which are weighted against each other according to their relative importance.

[9] Cohen, E. (1990). Analyse financière. édition économico, Paris, p. 502.

3. Methodology

This section aims to present the different stages of the scoring method in the context of budget deficit financing in Côte d'Ivoire. Two statistical techniques were used to develop the model: discriminant analysis and logistic regression. We used STATA[10] software to implement the above-mentioned statistical techniques.

Discriminant analysis is a statistical tool that can be used for descriptive and classification purposes to analyse a variety of situations in different fields, such as finance and marketing. It is used to model the value of a qualitative dependent variable and its relationship with one or more explanatory variables. Given a set of independent variables, the discriminant analysis attempts to find linear combinations of these variables that allow different groups of cases to be distinguished. These combinations are called discriminant functions.

The implementation of discriminant analysis is based on certain key assumptions :

- The explanatory variables are not highly correlated with each other;
- The average and variance of a given explanatory variable are not correlated;
- The explanatory variables are normally distributed;
- The correlation between two given explanatory variables is constant within the group (the variance-covariance matrix is homogeneous).

As some of the assumptions required for the application of discriminant analysis were not satisfied (notably that of the normality of the explanatory variables), we decided to use logistic regression, which accepts a wider range of distributions. Unlike discriminant analysis, logistic regression uses the Maximum Likelihood approach to estimate the model parameters. The error term is assumed to follow a logistic distribution.

The main objective of this research is to develop a statistical model that can distinguish between "good" and "risky" financing arrangements (with a high probability of default). The first step is, therefore, to define what we mean by "good" and "risky" financing methods.

A financing method is considered "good" if it is properly reimbursed and has not been overdue for thirty (30) days or more.

The current version of Stata incorporates a package and kernel update tool that allows regular updating and integration of new packages during its development. Packages published in the Stata Journal are often integrated between two versions of Stata. On the other hand, a

[10] Stata is a statistical software package created by William W. Gould. The first official version of Stata – originally available only on the PC – was released in January 1985, with the project having started only a year earlier. In 1993 he founded StataCorp, which develops the Stata software and manages related services such as training, technical support, publishing, annual user meetings, and of which he is still president. The current version of Stata incorporates a package and kernel update tool that allows regular updating and integration of new packages during its development. Packages published in the Stata Journal are often integrated between two versions of Stata.

financing mode is considered "risky" if it has at least once been late in repayment for thirty (30) days or more.

It should be mentioned that these definitions are the result of discussions with the staff of the Debt Repayment Branch. The presentation of the database requires the determination of a few essential elements, including:

- The target population;
- The default criterion;
- The sampling method;
- The variables.

In the course of data collection, we targeted the different ways of financing the budget deficit. For these different debt mobilisation instruments, we mainly used the Debt Management and Analysis System (DMFAS) to collect data on government credit lines, as well as other types of macroeconomic data from the database of the Department of the Economy (DGE).

We also had recourse to the branch of public debt reimbursement and grants to have more information on certain credit lines, on the causes of default and also in order to identify the variables linked to default.

In order to define the default criterion, we have accepted that the most important thing for a sovereign is not its ability to mobilise resources in the financial markets but its ability to meet its commitments, i.e. its claims.

To carry out this reallocation of our database, we have chosen as a criterion for default – the postponement of repayment of a debt by a given deadline.

This is the deferral of all or part of one or more debt service payments on one or more loans. The concept can be understood as the outcome of debt restructuring negotiations.

In other words, it can refer to a reorganisation operation that is undertaken jointly by a creditor and a debtor and that results in a change in the debt service profile with a view to alleviating the debt burden. This may involve the provision of a loan for debt restructuring or grants for debt relief. In the latter case, it may be undertaken unilaterally by the creditor. Debt restructuring includes debt forgiveness, debt rescheduling[11], debt refinancing[12] and debt conversion.[13] The database consists of 3223 credit lines. This distribution is based on

[11] Debt rescheduling can be defined as an official postponement of debt service payments with the application of new maturities to the postponed amounts. The maturities affected by rescheduling are those of the consolidation period, usually one to three years. This means that the discussions only cover the debt service falling due during this period.

[12] By refinancing, we mean the use of a new loan that either replaces the original loan or covers all or part of the payments due on the original loan.

[13] By conversion of debt, we mean any transaction that exchanges debt for either an asset or another debt. In the first case, the conversion can take the form of a debt-for-natural-resource investment swap, a purchase of debt at a lower price than the nominal value for reinvestment in the debtor country (transformation of an interest-bearing debt into a clean title), and in the second case it is a conversion of a debt, usually short-term, into another form of debt, most often a long-term bond issue.

qualitative variables. Furthermore, the results of the descriptive statistics indicate that, on average, defaulted loans have a maturity of (16.65) years, which is higher than the non-defaulted lines of credit by (9.74) years.

As for the interest rates, we obtain an average of 5.20% for the defaulting credit lines. While, the non-defaulted loans have an average interest rate of 3.96%.

Finally, the amounts of loans that defaulted are smaller than those that did not default.

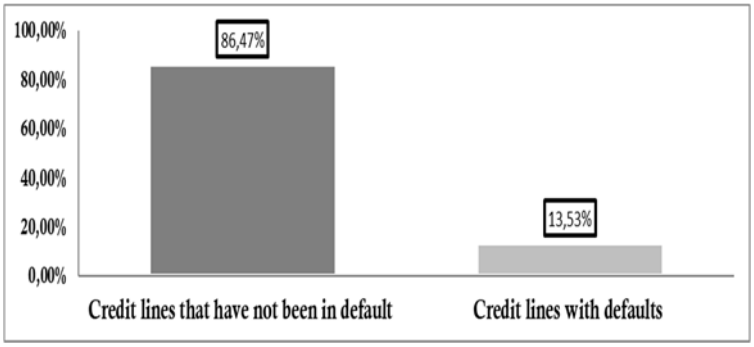
Table 1. Distribution of sample according to the probability of default on payment

Failure to reimburse	Freq.	Percent
0	2 787	86.47
1	436	13.53
Total	3 223	100.00

Source: Author based on data from the Department of Public Debt and Grants.

In addition, this database includes the qualitative variable "non-payment" which includes the value "1" if the loan defaults and "0" otherwise.

Figure 1. Lines of credit according to the probability of default on payment



Source: Author based on data from the Department of Public Debt and Grants

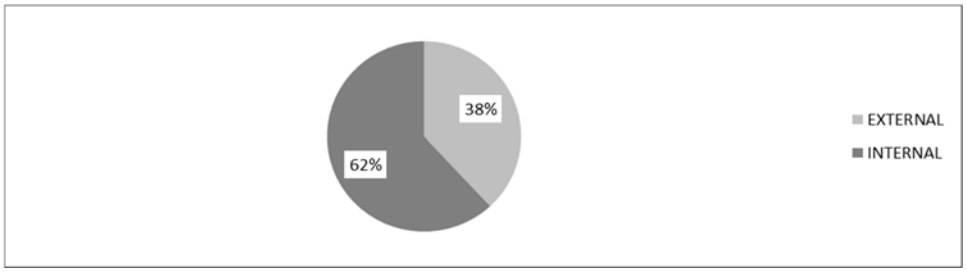
This chart shows that in our database (86.47%) of the credit lines did not default, while (13.53%) did default. Thus, our database is composed of two subsets: (38.07%) debt from external sources and debt from domestic sources (61.93%).

Table 2. Distribution of samples according to the source of debt

SOURCE OF DEBT	Freq.	Percent
EXTERNAL	1 227	38.07
INTERNAL	1 996	61.93
TOTAL	3 223	100.00

Source: Author based on data from the Department of Public Debt and Grants.

Figure 2. Assignment of lines of credit according to the source of debt



Source: Author based on data from the Department of Public Debt and Grants.

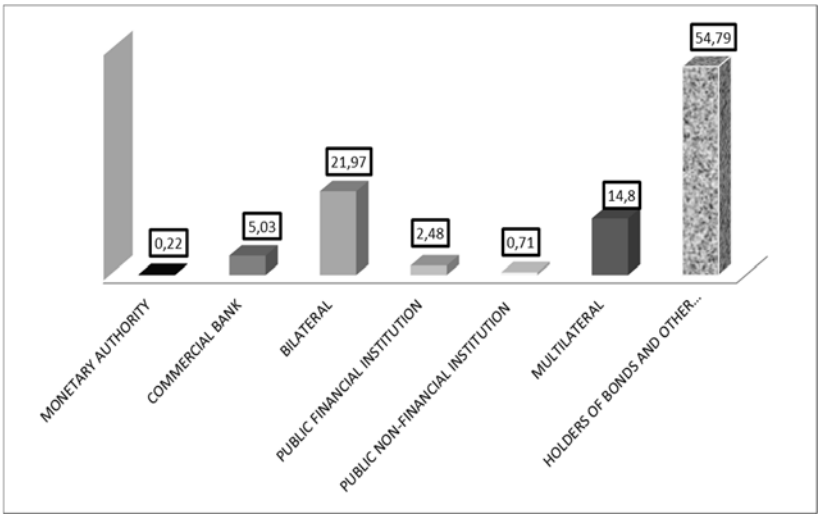
The following table provides the distribution of the database by type of creditor:

Table 3. Distribution of samples by type of creditors

Type_Creditor	Freq.	Percent
Monetary Authority	7	0.22
Commercial Bank	162	5.03
Bilateral	708	21.97
Public Financial Institution	80	2.48
Public Non-Financial Institution	23	0.71
Multilateral	477	14.8
Holders Of Bonds And Other Securities	1 766	54.79
Total	3 223	100.00

Source: Author based on data from the Department of Public Debt and Grants.

Figure 3. Assignment of lines of credit according to the types of creditors



Source: Author based on data from the Department of Public Debt and Grants.

Holders of bonds and other debt instruments are the types of creditors most sought after by the State to meet its financing needs. Thus, about 1/2 (54.79%) of the database is made up of bondholders and other debt holders compared to (21.97%) for bilateral loans.

Then, according to the database (14.8%) come from multilaterals, (5.03%) from commercial banks, (2.48%) from public financial institutions. The rest of the database is not sufficiently representative, notably non-public financial institutions (0.71%) and the monetary authority (0.22%).

Based on the theoretical framework developed and the availability of data, we identified and collected information on 3223 credit lines. The phenomenon we want to test is the possibility for a government to fulfil its commitments on the due date. In other words, we will try to determine the variables that have an influence on the probability of default.

We thus associate to the dichotomous dependent variable the ability of a country to meet its claims or not:

- Probability (Y = 1) if the government is in default ;
- Probability (Y = 0) if otherwise.

In order to determine whether the country has defaulted on its debt, we have based ourselves on a survey of the Department of Public Debt and Grants, notably the branch in charge of debt repayment, on each of the credit lines in our database. In the event that no defaults were observed, we consider that debt reimbursement had occurred. Our dependent variable will therefore be the dichotomous variable <<non-payment versus not defaulting>>. We assume that a government's decision to default on its debt is influenced by a number of variables.

Independent variables: choices and theoretical justifications

We selected eighteen (18) explanatory variables as indicators of a debtor country's financial and economic health and its ability to support its debt. The selection of variables is based on the consideration of the borrowing country's ability to repay its debt in the short and long term, but also a number of factors that could divert resources from debt payments. The choice of the latter was also dictated by the availability of data.

The definition of the different variables is derived from previous studies on the subject (Lemarbre, directed studies, 1992; Odedokun, 1995; IMF, 1998; Berhanu, directed studies, 2000; etc.).

The source of the debt

The source of debt can be a factor of vulnerability in meeting a government's commitments. Many developing countries, due to the lack of development of their domestic government securities market, often resort to the international financial market.

Consequently, a government that takes on foreign currency debt is exposed to foreign exchange risk. In other words, a change in the currency exchange rate can lead to an increase

in debt service by compromising its ability to service its debt. One would expect to have a positive coefficient if the source of the debt is external.

Types of creditors

Public indebtedness to official creditors can have an impact on the repayment capacity of a country. This is because each type of creditor defines the terms and conditions under which a loan can be obtained. Before funds can be released, the borrowing country enters into a loan agreement with the relevant lender. Thus, the clauses of this loan agreement act as a constraint for the borrowing country to fulfil its commitments. Under these conditions, the possibility of defaulting is low because the debtor country is exposed to no longer having access to the financial market. We should therefore expect the coefficients for these different variables to be negative.

Maturity

This indicator indicates the duration of a loan. For developing countries, a long maturity seems to be associated with a probability of default. Thus, a positive coefficient should be expected.

The interest rate and the exchange rate

These two factors (02) have an impact on the amounts of credit granted, which can be brutal when there is a shift in expectations. Indeed, these two elements played a central role in the 1982 debt crisis that hit Latin American countries. For low-income countries, however, these two factors play only a minor role, as their external financing is public. Also, interest rates are often very low and vary very little. Thus, these two variables should have positive coefficients.

Loan amount

The loan amount granted to a debtor country could have an impact on default. A State that mobilises large amounts of money to finance its budget deficit may be exposed to default on these amounts. The loan amount variable is an element of the possibility of default. Therefore, the coefficient of this factor is expected to be positive.

The rate of private investment

This factor helps to stimulate economic growth. An increase in investment helps to increase the productive capacity (output) of the country. Thus, as long as the growth rate of production is higher than the interest rate to be paid on the debt, the government has no difficulty in obtaining loans and, therefore, in repaying its debt.

On the other hand, if the growth rate is lower than the interest rate, there will be a negative capital inflow to the debtor country. This negative capital transfer will increase the probability of the country defaulting. This variable should have a negative coefficient (Soma, 1991; Berhanu, directed studies, 2000).

Rate of public investment

This ratio indicates the good economic health of the country and serves as a measure of the level of development of the indebted country.

The higher the ratio, the better the prospects for economic growth. Thus, the country will have a high probability of repaying its debt (Lemarbre, directed work, 1992; Odedokun, 1995; Berhanu, directed work, 2000). The coefficient on this variable is expected to be negative.

Debt service as a percentage of exports of goods and services

This ratio compares debt service, which represents a regularly recurring outflow of foreign exchange, to exports, which constitute the main inflow of foreign exchange. Thus, the larger the share of foreign exchange inflows that is consumed by debt service, the greater the risk that the country will not be able to adequately service its debt (Moghadam and Samavati, 1991; Lemarbre, directed study, 1992; Odedokun, 1995; IMF, 1998). The coefficient on this variable can therefore be expected to be positive.

Primary balance as a percentage of GDP

This variable measures the government's ability to finance debt servicing from a fiscal point of view. The more positive this ratio is, the more the government has sufficient resources to ensure the proper running of the economy and meet its commitments. This variable should have a negative coefficient.

External debt as a percentage of GDP

This factor measures a country's level of external indebtedness. The higher the ratio, the higher the vulnerability of the country to production problems. The coefficient of this variable is expected to be positive (Moghadam and Samavati, 1991; Lemarbre, directed study, 1992; Odedokun, 1995; IMF, 1998).

In Table 4 some key variables are defined.

Table 4. Definition of variables

Variables	Definition
Source of the debt	
SE	external source
SI	internal source
Types of creditors	monetary authority
X1	monetary authority
X2	commercial bank or other financial inst. financial
X3	bilateral
X4	public financial institution
X5	public non-financial institution
X6	multilateral
X7	holders of bonds and other debt securities
Other variables	
X8	maturity
X9	interest rate
X10	loan amount
X11	currency devaluation
X12	private investment rates
X13	rate of public investment
X14	debt service as a percentage of exports of goods and services
X15	primary balance as a percentage of GDP
X16	external debt as a percentage of GDP

Source: Author.

4. Empirical Results

The analysis of the relationship between non-repayment and some qualitative characteristics of the financing arrangements was carried out using cross-tabulations and related statistics (chi-square, contingency coefficients etc.).

Default and source of public debt

The Chi-square test indicates a possible relationship between default and debt source.

Table 5. Source of debt and default on payment

Default of payment	Source of debt		Total
	External	Internal	
0	825	1 962	2 787
1	402	34	436
Total	1 227	1 996	3 223

Source: Author based on data from the Department of Public Debt and Grants.

Pearson chi2(1) = 626.6556 Pr = 0.000

Thus, among the lines of credit that have not been subject to default, (29.60%) are from external sources, while 70.40% are from internal sources. Of the defaulted loans, (92.2%) are from external sources, while (7.8%) are from domestic sources.

Table 6. Source of debt and probability of default on payment

Default of payment	Source of debt		Total
	External	Internal	
0	825	1 962	2 787
	29,60	70,40	100
1	402	34	436
	92,2	7,8	100
Total	1 227	1 996	3 223
	38,07	61,93	100

Source: Author based on data from the Department of Public Debt and Grants.

Of the credit lines contracted in foreign currency (67.24%) were not subject to default, while those contracted in local currency, 98.30% were not subject to default.

Similarly, of the credit lines contracted in foreign currency (32.76%) were in default, while only 1.7% of the loans in local currency were in default.

Table 7. Source of debt and probability of default payment

Default of payment	Source of debt		Total
	External	Internal	
0	825	1 962	2 787
	67,24	98,30	86,47
1	402	34	436
	32,76	1,7	13,53
Total	1 227	1 996	3 223
	100	100	100

Source: Author based on data from the Department of Public Debt and Grants.

Thus, about (38.07%) of the database is from external sources. However, the majority of the credit lines are from internal sources (61.92%). In this category (13.52%) of the loans were in default against (86.47%) that were not in default.

Finally, in view of the above results, the external source of debt seems to be associated with a higher risk of default. This is a relatively normal situation given that the country generally practices what is called “original default” (Eichengreen et al., 2005).

In other words, since the country does not have a sufficiently developed domestic financial system and since their domestic currency cannot be used to borrow on the international market, they need to take on foreign currency debt and turn to foreign creditors for financing. Overall, the significance of the Chi-squared test allows this link to be established.

Default and types of creditors

After examining the independence between default and types of creditors, by the Chi-square test, which relies on two assumptions which are:

- H0: independence between default and types of creditors;

- H1: dependence between the two.

The Chi-square test shows the following results for the independence test (default - creditor types):

Table 8. Types of creditors and default on payment

Default of payment	X1	X2	X3	X4	X5	X6	X7	Total
0	3	147	318	75	21	476	1 747	2 787
1	4	15	390	5	2	1	19	436
Total	7	162	708	80	23	477	1 766	3 223

Source: Author based on data from the Department of Public Debt and Grants.

Pearson chi2(6) = 1.4e+03 Pr = 0.000

From this test, we find that default and creditor types are dependent. So the type of creditors has an impact on default. The State of Côte d'Ivoire mobilised about (89.45%) of its financing needs, despite its default rate, which is in the first place, followed by (4.36%) bondholders and other types of borrowing, (3.44%) commercial loans and (1.15%) public financial institutions, and finally (0.92%) the Monetary Authority, (0.46%) non-public financial institutions and (0.23%) lines of credit from multilaterals.

For the latter category, the results indicate that of the non-defaulted credit lines, about (17.08%) are from multilateral loans. This can be explained in part by the constraints and guarantees of international financial institutions prior to the full repayment of their loans.

On the other hand, (63%) of the cases of non-defaulted loans are due to credit lines with bondholders and other debt securities, (11.41%) are bilateral loans, (5.27%) are commercial loans, (2.69%) loans with public financial institutions, (0.75%) are non-public financial institutions.

Finally, in this same category, about (0.11%) comes from the monetary authority. In this sense, this result could be explained by the fact that seigniorage is a cheap source of financing for the State (Burda and Wyplosz, 2009).

The Treasury's loans from the Central Bank are generally contracted at very low or even zero rates. Thus, Hetzel (1997) points out that seigniorage is considered by some politicians as free financial resources.

Table 9. Types of creditors and probability of default on payment

Default of payment	X1	X2	X3	X4	X5	X6	X7	Total
0	3	147	318	75	21	476	1 747	2 787
	0,11	5,27	11,41	2,69	0,75	17,08	63	100
1	4	15	390	5	2	1	19	436
	0,92	3,44	89,45	1,15	0,46	0,23	4,36	100
Total	7	162	708	80	23	477	1 766	3 223
	0,22	5,03	21,97	2,48	0,71	14,8	55	100

Source: Author based on data from the Department of Public Debt and Grants.

Moreover, of the loans contracted with multilaterals, (99.79%) have not been subject to default. Indeed, for international financial institutions, the states requesting their intervention are also required to comply with budgetary discipline criteria. In this case, the IMF recommends that the public debt ratios of borrowing states should not exceed alert thresholds defined in the economic and financial programmes. Similarly, of the bondholders' credit lines, (98.9%) had no reimbursement problems.

In this category, loans committed to public financial institutions represent (93.30%), compared to (91.30%) for those contracted at non-public financial institutions, (90.74%) for lines of credit at commercial companies and (42.86%) for monetary authority. In the same vein, loans from the Central Bank and bilaterals had reimbursement difficulties of (57.4%) and (55.08%) respectively.

Table 10. Type of creditors and probability of default on payment

Default of payment	X1	X2	X3	X4	X5	X6	X7	Total
0	3	147	318	75	21	476	1 747	2 787
	42,86	90,74	44,92	93,75	91,30	99,79	98,9	86,47
1	4	15	390	5	2	1	19	436
	57,14	9,26	55,08	6,25	8,7	0,21	1,08	13,53
Total	7	162	708	80	23	477	1 766	3 223
	100	100	100	100	100	100	100	100

Source: Author based on data from the Department of Public Debt and Grants.

The analysis of the relationship between default and the type of creditor showed a strong link between these two variables. This result highlights that bilateral loans and seigniorage represent a higher risk of default than other types of creditors.

Indeed, for a state that is under-taxed or whose tax system is inefficient, that has to borrow at high-interest rates, or that does not have access to financial markets to finance itself, seigniorage may be a feasible financing option because of its ease of mobilisation and low cost.

Creditors usually consider the effectiveness and legitimacy of the policies that the government is putting in place before lending to it. They may consider that a government that chooses the easy way of monetary financing is a government that suffers from a crisis of illegitimacy or a crisis of incompetence.

Thus, they may feel that the government is not trustworthy, which leads them to reduce their refinancing offer and their credit offer to the government. The latter may then find itself unable to raise funds on the financial markets, which is certainly detrimental to the financial situation of the country.

Of all categories, domestic and multilateral debt appear to be associated with a low risk of default. The government can resort to issuing public treasury securities to meet its financing needs. Moreover, financial securities issued by the government are generally considered risk-free, which makes them very attractive to risk-averse lenders. The fact that government securities are considered low-risk investments (especially regarding default risk) should allow the government to benefit from both low-cost debt and higher competitiveness than other securities.

5. Construction of the Credit-Scoring Model and Analysis of the Results

For the establishment of the score function, the two most used statistical techniques are discriminant analysis and logistic regression; in the framework of the thesis, we opted for logistic regression since no ratio follows the Normal law, which favours the use of logistic analysis.

Unlike discriminant analysis, logistic regression uses the Maximum Likelihood approach to estimate the model parameters. In addition, the error term is assumed to follow a logistic distribution. Moreover, it allows the treatment of explanatory variables to be predicted with two values without making restrictive hypotheses. Parameters with positive coefficients influence the probability of default positively and those with negative coefficients affect it negatively.

In the equation, the source of debt, the types of creditors, the interest rate, the amount, the rate of public and private investment and the external debt/GDP reduce the probability of default when they increase.

On the contrary, maturity, currency depreciation, primary balance as a percentage of GDP and debt service as a percentage of exports of goods and services (SxP) have a positive relationship with the probability of default.

The results of the logistic regression provided by the STATA software have been listed in Table 11.

Table 11. Results of the logistic regression

Default of payment	Coeff.	Std. Err.	z	P>|z|		[95% conf. interval]
Source						
Internal	-2,5704	0,6874	-3,74	0,000	-3,9177	-1,2230
Type of creditor						
Commercial bank or other financial institutions	-4,7344	0,8843	-5,35	0,000	-6,4676	-3,0012
Bilateral	-3,9306	0,9808	-4,01	0,000	-5,8529	-2,0082
Public financial institutions	-3,6076	0,8464	-4,26	0,000	-5,2667	-1,9485
Public non-financial institutions	-2,7389	1,0748	-2,55	0,000	-4,8457	-0,6322
Multilateral	-10,4272	1,2140	-8,59	0,000	-12,8066	-8,0477
Bondholders and other debt holders	-3,2880	0,7016	-4,69	0,000	-4,6631	-1,9129
Maturity	0,0449	0,0051	8,72	0,000	0,0348	0,0550
Interest rates	-0,3063	0,0279	-10,94	0,000	-0,3612	-0,2514
Ln loan amount	-0,0578	0,0304	-1,9	0,000	-0,1176	0,0019
1.Currency devaluation	3,1666	0,5508	5,75	0,000	2,0869	4,2462
TIVP	-0,2267	0,0447	-5,07	0,000	-0,3144	-0,1390
TIVPU	-0,2390	0,0662	-3,61	0,000	-0,3689	-0,1091
SXP	-0,0815	0,0102	7,93	0,000	0,0613	0,1016
SPPIB	0,1924	0,0422	4,56	0,000	0,1097	0,2752
DEPIB	-0,0312	0,0035	-8,75	0,000	-0,0382	-0,0242
Constant	9,1749	1,2213	7,51	0,000	6,7810	11,5687

Source: Author based on data from the Department of Public Debt and Grants.

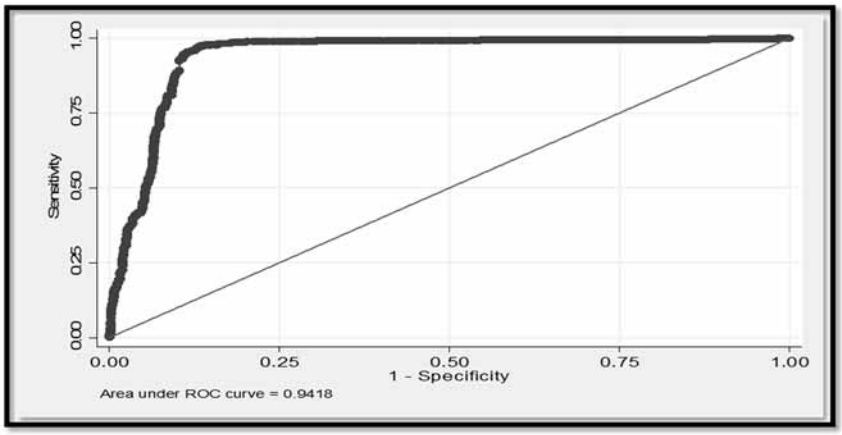
Taking ***p*** as the probability of default, the model estimation produces the following equation:

$$\log(\frac{\rho}{1-\rho}) = 9{,}17 - 2{,}57\,SI - 4{,}73\,X2 - 3{,}93\,X3 - 3{,}60\,X4 - 2{,}74\,X5 - 10{,}43\,X6 - 3{,}29\,X7$$

The probability of default p is then determined by the following equation:

$$\rho = \frac{1}{1 + e^{-9{,}17-2{,}57\,SI-4{,}73\,X2-3{,}93\,X3-3{,}60\,X4-2{,}74\,X5-10{,}43\,X6-3{,}29\,X7}}$$

Figure 4. Progress of the race ROC (Receiver Operating Characteristic)



Source: Author based on data from the Department of Public Debt and Grants.

When the ROC curve coincides with the diagonal, the score is better than a random model (where the class is assigned randomly). The closer the ROC curve is to the upper left corner, the better the model, as it captures as many true positives as possible with as few false positives as possible.

Consequently, the area under the curve represents the sensitivity of the model. In other words, the area under the ROC curve can be seen as a measure of the quality of the score. The criterion of the ROC curve varies between 0 (worst case) and 1 (best case). The value (1) indicates an ideal model and (0,5) – a random model. Thus, the logit model correctly predicts the probability of default in 94.18% of cases.

Using the logit regression method, we tested the relationship between the independent variables and the dependent variable, which represents the default or repayment of public debt. The sign (+) means that the variable has a positive impact on the probability of default and the sign (-) means that the variable reduces the probability of default.

Table 12 contains the results of the marginal effects of our estimates on the probability of default.

Table 12. Results of marginal effects on the probability of default

variable	dy/dx	Std. Err.	z	P>|z|	[95 % conf. interval]		X
_Isour~2*	-0,1567	0,0637	-2,46	0,014	-0,2815	-0,0318	0,6038
_Itype~3*	-0,0526	0,0073	-7,2	0,000	-0,06694	-0,0383	0,0506
_Itype~4*	-0,0937	0,0226	-4,14	0,000	-0,1381	-0,0493	0,2230
_Itype~7*	-0,0449	0,0063	-7,09	0,000	-0,0573	-0,0325	0,0262
_Itype~8*	-0,0400	0,0063	-6,31	0,000	-0,0525	-0,0276	0,0065
_Itype~9*	-0,1892	0,0249	-7,58	0,000	-0,2382	-0,1403	0,1597
_Ityp~10*	-0,1923	0,0655	-2,93	0,000	-0,3207	-0,0638	0,5306
maturity	0,0018	0,0002	6,34	0,000	0,0012	0,0023	11,2187
RATE_I~T	-0,0123	0,0017	-7,09	0,000	-0,0158	-0,0089	4,6229
lnMONT~T	-0,0023	0,0012	-1,86	0,000	-0,0048	0,00012	21,1782
_Idev_1*	0,4562	0,1367	3,34	0,000	0,1883	0,7242	0,0193
TVP	-0,0091	0,0020	-4,49	0,000	-0,0131	-0,0051	8,2347
TIVPU	-0,0096	0,0029	-3,32	0,000	-0,0153	-0,0039	4,5499
SXP	0,0032	0,0005	5,92	0,000	0,0022	0,0043	13,6731
SPPIB	0,0077	0,0018	4,11	0,000	0,0040	0,0115	-1,1264
DEPIB	-0,0012	0,0002	-6,14	0,000	-0,0016	-0,0008	63,0248

Source: Author based on data from the Department of Public Debt and Grants.

The marginal effects of our regression show the following results:

- When the source of funding for a loan is domestic, the probability of default is reduced by (15.67%) compared to funding from external sources. Sovereign defaults on external debt are far from rare;
- The probability of default is reduced by (5.26%) if the borrowing government mobilises resources from commercial banks and other financial institutions rather than the monetary authority. As a result, the probability of default is slightly reduced;
- When the government borrows from bilaterals, its probability of default is reduced by (9.37%) compared to the monetary authority;
- A borrower who mobilises financial resources from public and non-public financial institutions, the probability of default is reduced by (4.49%) and (4%), respectively, compared to the monetary authority;
- The model indicates that if the government borrows from multilateral institutions, then the probability of default is reduced by (18.92%). Thus, multilateral loans significantly reduce the probability of default compared to the monetary authority;
- A comparison of the marginal effects on default probabilities shows that credit lines to bondholders and other debt holders significantly reduce the probability of default compared to the monetary authority by (19.23%).

"Risky" financing methods

The results show that loans from bilaterals and commercial banks can be considered as "risky" financing. This mode of financing has a lower impact on the probability of default.

Indeed, bilateral claims normally take the form of loans from one sovereign State to another, often to finance exports from the creditor country or to provide development assistance. Generally, bilateral loans are made for non-profit purposes, but for public policy reasons, such as crisis response, official development assistance and trade development. One of the criticisms is that bilateral loans were given to increase the exports of the lending countries or to promote their geopolitical objectives.

Also, official bilateral creditors frequently restructure before or after default, both formally and informally, through new financing or restructuring of existing debt. Roubini and Setser (2004) find that private creditors generally face a higher risk of default and more pronounced restructurings than bilateral creditors.

In the same vein, Steinkamp and Westermann (2014) conducted a survey whose results show that there is a 65% probability that bilateral loans granted during the euro area crisis will be treated as senior claims.

Schlegl et al. (2017) find that Paris Club restructurings outnumber private creditor defaults and result in a larger haircut for official bilateral creditors. They find that sovereigns are more likely to run up arrears to official creditors than to private creditors.

Also, Rieffel (2003) and other economists have shown that "there is a general perception that bonds have priority over bank loans". This observation is supported by empirical evidence. Schlegl et al. (2017) found that bank loans were more likely than bonds to fall into arrears.

In general, rating agencies do not consider defaulting on debt to another government (e.g. S &P Global Ratings 2017; Fitch, 2018).

Less "risky" financing methods

The results obtained with the estimation of the Logit model show that the probability of default is strongly reduced when the government is financed by bondholders and other debt instruments and multilateral institutions.

Firstly, this result can be explained by the fact that economic theory has shown that fiscal policy has a positive effect on long-term economic growth by stimulating capital formation, employment and innovation. This fiscal policy acts on capital formation through public investments such as the creation or maintenance of infrastructure.

To finance itself, the government can resort to the domestic financial market via the issue of bonds. This channel makes it possible to raise financing on long maturities compared to bank credits. These issued public securities allow the government to raise stable resources to contribute to the financing of public investments.

In the same vein, more recently, Ndikumana et al. (2015) have shown that only domestic resources (savings and credit to the private sector), and very marginally foreign direct investment, have a significant effect on domestic investment and economic growth in Africa. These empirical analyses were done on a sample of fifty (50) African countries covering the period from 1971 to 2012.

In addition, the system of issuing government securities allows the borrower to repay the debt gradually while avoiding a large one-off disbursement at the last maturity date, when the capital must be repaid in full. This system offers the borrower the possibility to make staggered and progressive repayments, it also gives him the possibility to deduct the interest paid for tax purposes, and of course, it allows him to have funds at his disposal over a long period.

When the country decides to raise financial resources on the financial market, it will issue a long-term bond divided into a certain number of shares which will be subscribed to by a large number of lenders. The latter acquires negotiable securities issued by the State as part of its loan issue. At the same time, they become holders of bonds which carry a coupon representing the interest rate of the loan issued by the State.

In addition, the public securities issued are generally at a fixed rate. This is due to the advantages of both the investor being assured of repayment (principal and interest known in advance), and the issuer knowing at the time of issue the exact amount it is committed to repaying to its lender, hence the possibility of accurately assessing its financial needs.

Thus, the results obtained to establish that external debt, development aid and diaspora transfers do not have a significant impact on the level of investment. The mobilisation of domestic resources is a major challenge for the State because of the opportunities of this financing resource.

Second, mobilising resources from multilateral institutions tends to lower the probability of default. This result could be explained by the fact that the IMF, the World Bank and the Regional Development Banks give high priority to public debt management.

Indeed, three attributes distinguish multilateral institutions:

- the multilateral shareholding structure;
- a subsidised capital base and access to other sources of subsidised funding;
- a privileged creditor status.

These attributes determine how Multilateral Banks select and monitor loans. They create incentives to comply with the terms and conditions of financing agreements. They also enable Multilateral Banks to provide grants as part of their financial and non-financial operations.

Loans from the World Bank, the African Development Bank, the Asian Development Bank, and the Inter-American Development Bank are mainly loans to governments. These are a form of budgetary financing, which is largely fungible in the sense that it frees up public resources for alternative uses until the loans are repaid. As financing mechanisms, Multilateral Banks have a number of features in common with micro-credit organisations, including the fact that they provide financial resources in high-risk contexts where legal and other institutional arrangements are underdeveloped.

According to Morduch (1999) and Armendariz de Aghion and Morduch (2000), micro-credit organisations have the particularity of mobilising social groups to screen and monitor the loans they grant. They also use threats of non-repayment, which, in the absence of alternative

sources of credit, encourage agents to repay. Finally, they create substitutes for traditional guarantees, such as self-insurance systems for borrowers against the risk of default.

Rather than relying on social groups, the Multilateral Banks rely on governments by involving them in the review of financing operations that are associated with domestic reforms. For these operations, the willingness of governments to reform is crucial.

The Multilateral Banks also exploit the incentives for compliance that arise from their repeated interactions with governments, as well as from their status as preferred creditors.

In addition, one of the major contributions of multilateral development banks is their ability to provide credit to middle-income countries at relatively low-interest rates. They succeed because, thanks to their financial credibility, they can raise funds on the markets on extremely favourable terms and pass the savings on to borrowers.

To this end, the loans granted to governments by multilateral banks are, on average, less expensive than the loans contracted by these countries on the international bond markets. The anticipated default rates on loans from Multilateral Banks are significantly lower and the anticipated repayment rates much higher than in the case of bonds and other types of international private financing.

Interest rates on loans to governments are set well below the interest rates at which governments can obtain financing on international capital markets.

Among multilateral, bilateral and private creditors, multilateral creditors are less likely to face a sovereign default (Schlegl. et al. 2017) and even less likely to participate in a restructuring. Public and private creditors have generally accepted that IMF financing, in particular, should be excluded from sovereign debt restructurings because IMF lending in a crisis situation is a public good that helps solve balance of payments problems (Lasra, 2014; Steinkamp, and Westermann, 2014; IMF, 2009; Rieffel, 2003).

Finally, among the mechanisms that promote compliance with the terms and conditions of Multilateral Bank loans are the dynamic incentives that emanate from the repeated interactions between borrowing governments and institutions. The potential for loan renewals, combined with the credible threat of future loan interruptions in the event of non-compliance with the terms and conditions set by the Multilateral Banks, can also help to ensure that the borrower will fulfil its commitments and decrease the possibility of non-payment.

Conclusion and Recommendations

The objective of this study is to analyse the effectiveness of budget deficit financing methods in Côte d'Ivoire. To do so, a brief review of the literature was necessary to explain the concept of credit scoring.

In Côte d'Ivoire, even if the public debt is considered sustainable, the analysis of sustainability by ratios (Debt sustainability analysis or DSA) has two limitations. On the one hand, these ratios are static because they do not take into account the evolution of the debt

over time. On the other hand, these ratios do not take into consideration Côte d'Ivoire's relationship with its financial partners. This relationship is a determining factor in the granting of loans, whether bilateral, multilateral or public securities.

Thus, in this article, we wanted to take these aspects into account and propose a credit scoring model adapted to the analysis of the effectiveness of the budget deficit financing methods in Côte d'Ivoire. This model will enable the Government of Côte d'Ivoire to evaluate the relevance of the different instruments for financing its budget deficit in relation to a default variable.

The choice of this model is based on default risk measures previously used for the private sector that have been redesigned for practical application in the public sector. These include Altman's Z-score model (1968) and Altman and Rijken's Z-Metrics model (2010). Also, rating agencies have their own measures of sovereign default risk. For Moody's, for example, there are indicators based on the KMV model (Crosbie, KMV, 1999). Brodsky et al. (2011) of the BlackRock Investment Institute propose a Sovereign Risk Index (SRI) and a Sovereign Vulnerability Index (SVI) that are used as benchmarks in financial markets. All these measures increasingly take into account the multidimensional nature of sovereign default risk. However, they are generally set for creditors even if the implications are important for borrowing states.

As a result, the results of our study of budget deficit financing instruments show that multilateral loans and public securities issues reduce the probability of payment default. Multilateral loans and government securities are the most appropriate financing methods to address the financing of the budget deficit in Côte d'Ivoire in order to avoid a payment default crisis. In other words, to ensure the country's debt sustainability, these financing instruments should be prioritised. The government should, therefore, seriously consider the necessary reforms to promote the use of these different instruments, as the model perfectly predicts the probability of default, i.e. 94.18%.

In the same way, Carlos Santiso (2006) shows that multilateral institutions contribute in various ways to the implementation of international standards of good financial and fiscal management in countries. He explains that the use of multilateral financial institutions to finance the national economy helps to improve public finances and fiscal governance. This thesis confirms our results because the intervention of multilateral institutions in the financing of the budget deficit strongly contributes to guarantee the sustainability of public debt through these conditionalities.

Based on these results, this study makes some recommendations. Firstly, since recourse to multilateral loans reduces the probability of default, it is important that the government take steps to further encourage budget deficit financing through the windows of multilateral institutions. To this end, the government should undertake reforms aimed at complying with evolving international standards of sound financial and fiscal management, which is a prerequisite for attracting multilateral financing.

Secondly, as government securities issuance has a positive impact on the probability of default, policymakers are encouraged to take actions to increase government securities issuance.

Françoise Magnan-Marionnet (2016) is right to argue that the development of the public securities market can play a significant role in raising resources and thus be a major catalyst for economic growth. Indeed, it allows for a better allocation of capital by offering alternative sources of financing and by diversifying risk among a large number of investors.

Thus, considering the results of our modelling, a number of measures can be taken to encourage the use of government securities:

- Strengthen communication with market participants, the Professional Association Management and Intermediation Company, the Undertakings for Collective Investment in Transferable Securities and institutional investors in particular, through the establishment of a permanent consultation framework;
- Continue the partnership with business providers and other authorised financial market participants (Undertakings for Collective Investment in Transferable Securities (UCITS), Asset Management Companies, etc.);
- Diversification of the investor base, particularly outside the West African Economic and Monetary Union (WAEMU);
- Intensified promotion of government securities to insurance companies, pension funds etc.;
- Expanding the secondary market for government securities;
- Improved financial communication would strengthen the Treasury's position with investors and financial partners;

Finally, the objective of guaranteeing fiscal sustainability in Côte d'Ivoire is supported by the need to increase government revenue. Since tax revenues constitute the majority of the country's income, tax policy is the preferred means. Fighting fraud and corruption is an essential factor in the sustainability of the tax system, as it could lead to an increase in the collection of tax resources.

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